DEVELOPING A STANDARD OPERATING PROCEDURE FOR FIREFIGHTER REHAB IN ORANGE COUNTY FIRE RESCUE DEPARTMENT

EXECUTIVE LEADERSHIP

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CERTIFICATION STATEMENT

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate and that appropriate credit is giver I have used the language, ideas, expression, or writing of another.

Signed: 

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ABSTRACT

The problem identified for this applied research project is that while OCFRD has been in existence for 23 years, a Standard Operating Procedure (SOP) for firefighter rehab on emergency incidents has never been developed. Although the winter climate is considered mild, the summers are hot, humid, and last approximately eight months.

The purpose of this research paper is to develop an SOP for firefighter rehab during emergency incidents. The procedures used to complete this research included a literature review, a personal interview, an Internet search, and a survey of fire departments of similar climate that may encounter similar conditions.

Descriptive and evaluative research techniques were used to answer the following research questions:

1. What factors should be used to determine when a firefighter should be sent to rehab?
2. What resources are required to establish an incident Rehab Sector?
3. What medical protocols should be followed during firefighter rehab?
4. What fluids and foods are recommended for firefighter rehab?
5. What factors indicate that a firefighter is rested and can return to incident operations?

The results of this research indicate the need for an Emergency Incident Rehab SOP for OCFRD as well as any fire department without a SOP of this type. This research also showed the improved safety and health benefits provided by an organized Rehab operation.

Recommendations included establishing and implementing an Emergency Incident Rehab SOP and training personnel on the benefits and proper procedures needed to comply with the SOP including the necessary documentation. It is also recommended that the Orange County EMS Council and the Medical Director research and consider the implementation of a heat stress

protocol for all fire departments in Orange County. Finally, every fire department without an Emergency Incident Rehab SOP should develop and initiate one.

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INTRODUCTION

Orange County Fire Rescue Department (OCFRD) provides fire protection and Emergency Medical Service to most of unincorporated Orange County, Florida. OCFRD employs approximately 900 full-time paid firefighters and has a Volunteer Program with approximately 40 firefighters. OCFRD was created in October of 1981 through the consolidation of sixteen different fire districts.

Although the winter climate in Central Florida is considered mild, the summers are hot, humid, and last approximately eight months. During these hot and humid months, firefighters can quickly reach the point of exhaustion. These extreme conditions promote the probability of injury to firefighters and others on the incident scene. The problem is that while OCFRD has been in existence for 23 years, a Standard Operating Procedure (SOP) for firefighter rehab on emergency incidents has never been developed.

The 2003 Edition of the National Fire Protection Association (NFPA) 1584 states, "An integral component of both an occupational safety and health program and incident scene management is an organized approach for fire department members' rehabilitation at incident scene operations" (p.1). The purpose of this research paper is to develop an SOP for firefighter rehab during emergency incidents using current techniques to ensure firefighters are rested, recuperated, and rehydrated before returning to active operations.

Descriptive and evaluative research techniques were used to answer the following research questions:

1. What factors should be used to determine when a firefighter should be sent to rehab?
2. What resources are required to establish an incident Rehab Sector?
3. What medical protocols should be followed during firefighter rehab?

4. What fluids and foods are recommended for firefighter rehab?
5. What factors indicate that a firefighter is rested and can return to incident operations?

BACKGROUND AND SIGNIFICANCE

OCFRD was formed in October of 1981 by combining sixteen separate fire control districts. The department provides Fire and EMS to most of unincorporated Orange County, Florida. There are 36 operational stations with one more under construction. Each shift staffs 35 engine companies, 24 Advance Life Support (ALS) rescues, five truck companies, three hazardous materials squads, an air and light truck, and an ALS transport helicopter. OCFRD also has six water tanker trucks and 14 four-wheel drive brush trucks, which are not staffed full-time, but are available for response as needed. A Rehab truck is available for response and is normally manned by volunteers.

In spite of the size and age of the department, an incident rehab SOP does not exist. However, an SOP exists for the deployment of the Rehab truck on incidents and that a Rehab Sector should be established. On an average house fire, the Incident Commander assigns an ALS rescue crew to initiate a rehab sector. This crew provides water and may take vital signs in an area of shade. On larger incidents, the Rehab truck is usually requested. The crew of the Rehab truck usually works with the Rescue crew and provide snacks and sports drinks to personnel involved in emergency operations. Without an SOP, incident rehab is not standardized and is inconsistent. Only a minor amount of medical monitoring is initiated and usually without any documentation. Only firefighters needing transport to an Emergency Room for heat stress or exhaustion receive complete treatment with documentation.

All too often, firefighters tend to exert themselves to the point of exhaustion during emergency scene operations. Many times, firefighters will refuse to take a break until the

incident is under control. This mindset can diminish the overall safety of scene operations (Treadwell, 1999, p. 5). On this topic, Angeli (2000) states, “Firefighter rehab is designed to ensure that the physical and mental well-being of member operation at the scene of the emergency (or training exercise) do not deteriorate to the point of where it affects the safety of any other member.” He further states, “According to the Federal Emergency Management Agency (FEMA), any activity/incident that is large in size, long in duration and/or labor intensive will rapidly deplete the energy and strength of personnel and therefore merits consideration for rehabilitation”.

Chris Eckert (1996) assesses firefighter rehab as, “The systematic removal of personnel from an incident scene for the purpose of providing rest, replacement of body fluids, and assessment of the overall physical and mental condition of the individual at the emergency scene.” Eckert (1996) also describes an incident in which he had been sent to rehab. He stated that he felt tired which was normal for him after physical exertion on an incident. EMS personnel found his pulse to be rapid and irregular, and he was transported to the hospital for evaluation and possible treatment. After being diagnosed with atrial fibrillation, he was subsequently treated and released to return to full duty status. This incident demonstrates the importance of an organization having an Incident Rehab Program, which can intercept medical problems before they become life threatening.

The importance of having a heat stress recognition component in an Incident Rehab Program is emphasized by Haftl (1998) in his description of a tragic incident that occurred in California. On the morning of May 30, 1997, California Conservation Corp firefighter David Ray died of heat stroke. The medical examiner’s report listed the cause of death as “hypoxic

encephalopathy, due to environment hyperthermia (heat stroke)." Firefighter Ray was on his first wildland fire working in high heat and high humidity conditions.

This research project directly relates to the U.S. Fire Administration's five-year objective of reducing the loss of life from fire by 15%. An additional part of the objective includes the reduction of 25% in the loss of life among firefighters. A properly administered Incident Rehab Program can prevent injury and the loss of life due to environmentally induced heat stress. Further, proper rest, rehydration, and early recognition of medical problems with subsequent care can reduce firefighter fatalities.

LITERATURE REVIEW

What factors should be used to determine when a firefighter should be sent to rehab?

NFPA 1584 (2003) states "Rehabilitation operations should commence whenever emergency operations or training exercises pose the risk of members exceeding a safe level of physical or mental endurance." In addition, NFPA 1584 states Rehabilitation Operations should consider temperature, relative humidity, and direct sunlight as factors in hot weather. This Recommended Practice refers to a Heat Stress Index table for additional guidance (p. 6 and 9). A copy of the table is provided in Appendix A.

NFPA 1584 also encourages the Incident Commander to consider the scope of the operation and recognize the need to evaluate the incident with regard to time, complexity, and intensity. Time refers to the period of operation in bunker gear and exposure to the climate. Complexity refers to the difficulty in the completion of the work, such as search operations or standoffs. Intensity is the mental and/or physical stress endured by the members during an operation such as a major extrication or interior search and rescue (p. 6).

The Federal Emergency Management Agency/United States Fire Administration (FEMA/USFA) publication *Emergency Incident Rehabilitation* (FA-114/July 1992) for the establishment of a Rehab sector/group is a sample standard operating procedure (SOP). It indicates the need for a rehab area when the climate places the heat stress index above 90^{o} F. The heat index is the same as the one used in the NFPA 1584 (2003) guideline (Appendix A). FEMA/USFA (1992) also recommends the "two air bottle rule" or 45 minutes of work or exertion prior to a mandatory rehabilitation. With an objective evaluation of the member's fatigue level, the member should receive at least eight ounces of fluid for rehydration and rest for not less than 10 minutes. The SOP goes on to state that fatigued members are to be rested, evaluated, and then released by the Rehab Officer.

Bonnano in an article for *Health and Safety* describes the importance of replacing carbohydrates during periods of heavy exertion by firefighters. Glycogen is the form of carbohydrate stored in the liver and muscles. Physical firefighting operations can significantly deplete muscle glycogen stores, which can have numerous effects on the body's ability to perform. Lower levels of glycogen hinder the upper levels of muscular exertion, and this depletion is the primary cause of fatigue. In addition, mental status can change causing poor judgment and decision-making. Bonnano goes on to state that after 30 to 45 minutes of anaerobic activity, a firefighter's body will actively seek to replenish depleted glycogen stores. If carbohydrates are not available, the body will break down its own muscle tissue to convert it to blood sugar to satisfy energy and glycogen needs (Bonnano, 1996).

Dehydration is also a significant problem that must be addressed. Heavy physical exercise, especially in hot weather, can cause the body to lose up to 3% of its total weight in 90 minutes. The fluid lost through respiration and perspiration must be replaced or the individual

could develop an irregular heartbeat and cause damage to the heart or nervous system (Bonanno, 1996).

Angeli (2000) states that, “All personnel should report to the rehab sector immediately following:

1. Strenuous activity;
2. The use and depletion of two SCBA bottles;
3. Thirty minutes of operation within a hazardous/dangerous environment; and
4. Failure of an SCBA.”

Carafano (1990) also recommends, “After the use of two SCBA air bottles (or 30 minutes of strenuous activity), a firefighter must be evaluated at the rehab area.” In addition he feels, “When setting operation limits for firefighters, contact area physicians to assist in forming workable parameters. The general physical condition of the department work force and the geographical area, plus each department’s individual situation, must be taken into account.”

In summary, NFPA 1584 (2003) suggests the incident commander should use his/her discretion as to when emergency incident personnel should be sent to rehab. Angeli, Bonanno, Carafano, and FEMA/USFA support a rule of 30 to 45 minutes of strenuous activity as a guideline for sending emergency incident personnel to rehab. Angeli, Carafano, and FEMA/USFA suggest using the “two-air bottle rule” as a rough guideline for sending a firefighter to the Rehab Sector. Carafano also stresses a SCBA failure as a guideline for members being required to report to rehab. Bonnano cites his reasoning for sending members to rehab after 30 to 45 minutes of strenuous activity is due to fluid, electrolyte, and carbohydrate depletion.

What resources are required to establish an incident rehab sector?

FEMA/USFA (1992) states, "The Incident Commander will establish a Rehabilitation Sector or Group when conditions indicate that rest and rehabilitation is needed for personnel operating at an incident scene or training evolution." This sample SOP also states, "A member will be placed in charge of the sector or group and shall be known as the Rehab Officer." Angeli (2000) expresses his agreement with the FEMA/USFA publication that a Rehab Sector must be under the command of a fire or EMS officer.

Becker (2000) recommends that a Rehab Officer needs to function like any other sector, branch, or division officer. This officer should utilize common incident management system practices. The Rehab Officer must coordinate the flow of personnel in and out of the Rehab Sector with the Incident Commander. This is usually done utilizing the practice of first in/first out. The Rehab Officer is responsible for ensuring a proper site, procuring personnel for medical assistance, obtaining needed supplies and equipment, and documenting assistance to active incident personnel.

Angeli (2000) states that the location for the Rehab Sector should be suitable to provide protection from the environment, such as a shady area in hot weather and a warm, dry area in cold, rainy weather. The area also needs to be free of hazards such as fumes, smoke, or gases from the incident or exhaust from vehicles. In addition, the location needs to be readily accessible to EMS-rescue personnel and their equipment for transport of personnel or replacement of supplies. Angeli also suggests close proximity of the air supply to enable members to return to operations with a fresh tank.

Becker (2000) supports Angeli's (2000) site characteristics and recommends an area that has an easy access and supports the removal of protective clothing and equipment. He goes on to state that it is convenient if the Air Supply Sector can be located adjacent to the Rehab Sector. He also suggests an area far enough away to keep crews from watching the action and possibly rushing back into the incident if conditions intensify.

FEMA/USFA (1992) adds to the site requirements of an area that the area should provide for prompt re-access to the emergency incident. The Rehab location should also be large enough to accommodate multiple crews. FEMA/USFA (1992) and NFPA 1584 (2003) are most comprehensive and incorporate all of Becker (2000) and Angeli's (2000) requirements for the Rehab sector site.

Angeli (2000) suggests that at least two trained EMS personnel should be assigned to the Rehab Sector to access, monitor, and assist firefighters. The EMS personnel should be at least BLS trained though ALS is preferred. He also recommends immediate transport to a definitive healthcare facility if serious symptoms are presented to EMS personnel by firefighters during assessment.

Becker (2000), in agreement with Angeli (2000), supports the use of trained EMS personnel in the Rehab Sector to reduce the chance of collapse of personnel due to cardiovascular complications. He recommends that EMS personnel should be able to perform and document medical evaluations, which include vital signs, mental status, and pulse oximetry readings. If firefighting personnel should need to be transported to an Emergency Room, he suggests using an ambulance, not involved in the rehab operation.

Similar to Angeli (2000), NFPA 1584 (2003) and FEMA/USFA (1992) recommend the use of ALS trained personnel for EMS staffing assigned to the Rehab Sector. Personnel assigned to work in the medical treatment area should be distinct from those assigned to the Rehab Sector.

FEMA/USFA (1992) states drinking water must be available without regard to the size of the incident. Other fluids such as commercially prepared activity beverages may be provided as well. Depending on the size and duration of the incident, FEMA/USFA (1992) also suggests that fruits such as apples, oranges, and bananas provide excellent forms of energy replacement. In addition, soups, broths, or stews are warm foods suggested for fast digestion over fast-food products.

Wieder (2000) recommends water for fluid replacement on any incident in which a rehab area is established. During incidents exceeding three hours in duration, he suggests food be provided, preferably bananas and high-energy bars due to individual packaging and ease in serving. Warm food may be necessary if the weather is cold or meals are missed due to the length of the incident.

Additional supplies and equipment suggested by FEMA/USFA (1992) include awnings, tarps, fans, heaters, dry clothing, blankets, towels, and fireline tape. Obviously, the size of the incident and its duration coupled with the resources available to a department dictate the need for these additional supplies and equipment. Becker (2000) suggests the assistance of the Red Cross, the Salvation Army, ladies auxiliary, or other specialty canteen resources to assist in providing food or meals for a long duration incident.

Heightman and O'Keefe (2000) emphasize the variety and the extent to which a Rehab Sector can be expanded and equipped. The equipment available is only limited by the department's budget and imagination. Equipment available include inflatable shelters, awnings

mounted on vehicles, rapid deployment canopies, misting or fogging systems, cooling vests, specialized heaters and specialized rehab response vehicles. They also hold with the basics, such as water supplies and log sheets for documentation. Trashcans need to be provided to ensure wrappers, cups, and other trash is not left on the owners' property.

In summary, Angeli (2000), Becker (2000), and FEMA/USFA (1992) support placing Rehab Operation under the direction of a Rehab Officer. This officer is given the responsibility of ensuring the Rehab Sector is properly located, equipped, and staffed, and that activities are documented. Angeli (2000), Becker (2000), FEMA/USFA (1992) and NFPA 1584 (2003) recommend placing the Rehab Sector in a location convenient yet suitably distant away from the incident. The site should provide some protection from the elements and be free of exhaust fumes or smoke. In addition, the site should be large enough for the incident and adjacent to an area for medical treatment and transport. Angeli (2000) also suggests close proximity of the air supply to enable members to return to operations with a fresh tank.

Angeli (2000), Becker (2000), FEMA/USFA (1992), and NFPA 1584 (2003) recommend staffing the rehab site with two medical personnel, including at least one paramedic to evaluate incident members. Additional equipment should include medical equipment, tarps, water coolers, canopies, and a variety of other items based on the climate, the size, and the duration of the incident. Becker (2000) suggests utilizing the Red Cross, the Salvation Army, or other canteens to support the need for refreshments and food.

What medical protocols should be followed during firefighter rehab?

Heightman and O'Keefe (2000) state:

"For decades, half of all on-duty firefighter deaths have resulted from heart attacks and strokes. Emergency incident rehab assumes that if medical personnel closely monitor

> firefighter and other rescue personnel during periods of physical stress, vital-sign trends will help identify personnel at immediate risk for developing and succumbing to these stress related illnesses."

In addition Heightman and O'Keefe (2000) stress tachycardia and severe changes in blood pressure "represent significant alterations in cardiovascular physiology."

Wieder (1999) recommends firefighting personnel sent to rehab should remove their SCBA, turnout coat, and hood. Personnel should be evaluated for injuries and for heat and/or stress-related illnesses. He stresses an initial set of vital signs be taken which includes blood pressure, heart rate, and temperature. Rehab medical staff also need to be aware of any potentially life threatening complaints such as shortness of breath or chest pain. However, medical evaluation in the rehab area should not preclude firefighters from getting proper rest and rehydration.

NFPA 1584 (2003) recommends that members upon arrival to the rehab area be evaluated for their Rate of Perceived Exertion (1 to 10 scale), heart rate, blood pressure, and temperature. NFPA 1584 (2003) further suggests a fire department physician establish the parameters for medical evaluations (p. 7). In addition, EMS personnel should further question members arriving at rehab to establish if symptoms of dehydration, cold or heat stress, exhaustion, or cardiopulmonary abnormalities are present (p. 6).

FEMA/USFA (1992) stresses the importance of medical evaluations of incident operational personnel with heart rate and temperature evaluations as soon as these personnel arrive in the rehab area. In addition, the recommendation states EMS personnel need to be assertive in their attempts to diagnose potentially serious medical problems early. FEMA/USFA (1992) emphasizes the importance of documenting all medical evaluations including names,

date, complaints, and times in/out of the rehab area. FEMA/USFA (1992) also recommends a member sent to the Rehab Sector should have their pulse checked for 30 seconds as soon as possible. If the heart rate exceeds 110 beats per minute, an oral temperature should be taken. If the firefighter's temperature exceeds 100.6° F., he/she should receive additional medical evaluation and not be allowed to wear protective equipment. If the temperature is below 100.6° F., and the heart rate remains above 110 beats per minute, then time in rehab should be increased. Heat stress is negligible in firefighters presenting with a pulse of less than 110 beats per minute.

Angeli (2000) stresses that medical evaluations include pupil dilation, the Glasgow coma trauma score, lung sounds, body core temperature, skin condition, and/or color and administration of ECG if chest pain or an irregular heartbeat is discovered. Angeli also follows the heart rate and core temperature recommendations established by FEMA/USFA (1992).

Sachs (2001, p. 73-74) concurs that many times heart attacks present with warning signs that are easily detected by EMS personnel in the Rehab Sector. He advocates that a complete set of vital signs with a temperature reading should be taken of members reporting to the rehab area. In addition, he supports the use of pulse oximetry to determine the oxygen saturation of the blood. Any personnel involved in the incident showing increased blood pressure, irregular heartbeat, and disorientation, or poor oxygen saturation should receive additional evaluation. In agreement with Angeli and FEMA/USFA, all medical evaluations should be recorded. This includes entry and exit evaluations from the rehab area.

Sachs (2001, p. 75) further states that just because a member has not been involved in the physical aspects of the incident does not mean the person has not endured stress. There have

been numerous incidents in which the Incident Commander or another officer has presented abnormal vital signs when entering the rehab area. The two objectives of rehab are:

1. "To provide an On-scene screening process to help determine if any personnel operating there are in danger of collapsing because of cardiovascular complications; and
2. to monitor how firefighters are reacting physiologically and emotionally to the stress of the particular operation."

Treadwell (1999, p. 21) recommends blood pressures and pulse rates should be taken and recorded as soon as a member reports to the Rehab Sector. Treadwell (1999) cites guidelines suggested by Training Chief Debbie Morris for the Lubbock County EMS in determining when ALS personnel should further evaluate firefighters in the Rehab Sector:

1. "Firefighters diastolic blood pressure is greater than 110 mm Hg
2. Firefighters systolic blood pressure is greater than 180 mm Hg
3. After 15 minutes in rehab the firefighters pulse is above 140 beats per minute
4. The firefighter is symptomatic."

To summarize, FEMA/USFA (1992) emphasize the importance of medical evaluation when members report to the Rehab Sector. Personnel need to remove most of their protective equipment, have their heart rate checked, and have their temperature taken if the heart rate is above 110 beats per minute. This is the minimal physical evaluation. Heightman and O'Keefe (2000) and Wieder (1999) stress the importance of including blood pressure readings for members who are evaluated. Angeli (2000) and Sachs (2001) support the additional use of pulse oximetry in the evaluation of members. Treadwell (1999) provides a set of parameters for members that should receive additional evaluation by ALS personnel. All of the sources cited

suggested EMS personnel should be aggressive in an effort to find potentially serious medical problems early.

What fluids and foods are recommended for firefighter rehab?

NFPA 1584 (2003, p. 7) stresses the importance of fluid replacement by stating, "Multiple locations for self-fluid replacement should be established, based on the size and duration of the incident." This recommendation goes on to state, "In the rehabilitation area, fluid intake should be increased to [sic] 12 oz. to 32 oz. during a 20-minute rest period." In addition the standard recommends, "When operating in temperature extremes (hot or cold), members should increase fluid intake." NFPA 1584 (2003, p.11) further states that, "Because plain water ingestion may suppress thirst and increase urine output, it is less effective for rapid rehydration than sports drinks." This recommendation goes on to suggest that 8 oz. of sports drink should contain 15 g. of carbohydrate."

FEMA/USFA (1992) also recognizes the importance of fluid replacement and states, "Water must be replaced during exercise periods and at emergency incidents. During heat stress, the member should consume at least one quart of water per hour." In addition, the rehydration solution should be a 50/50 mixture of water and commercially prepared sports drink served at about 40° F.

Wieder (2000) states that personnel performing heavy work under stress and wearing heavy protective clothing are subject to excessive fluid loss, and also recommends, "A 50/50 mixture of water and sports activity beverage" for fluid replacement.

However, Bonanno (1996) recommends water as the fluid of choice for fluid loss during periods of heavy exercise. He further states the kidneys effectively conserve electrolyses and there is little evidence to suggest electrolyte replacement is needed except in situations such as

encountered by endurance athletes. Bonanno (1996) does recognize the importance of carbohydrate replacement as well. He recommends a carbohydrate-based recovery drink with the key ingredient of Maltodextrin along with the mix of dextrose and fructose. Bonanno (1996) emphasizes, "A final word is to read the label and ingredient list on your drink of choice! If the first few ingredients are sugar, glucose, glucose syrup and it has dyes, vegetable oils or rosins, steer clear."

Dickinson and Wieder (2000, p. 112) propose the nutritional and fluid replenishment requirements of firefighters will vary from one incident to another. The needs of a fire crew working a room and contents fire will be far less than a crew controlling a wildland fire for 16 hours (p. 111). They also suggest viewing firefighter needs for fluid and nutritional support in rehab as a triangle. Dickinson and Wieder (2000, p. 112) state, "The triangle's sides are made up of (1) the fluid/nutritional needs of personnel, (2) the local resources available to provide for those needs and (3) the ability of firefighters to retain and digest the fluids or foods provided."

Dickinson and Wieder (2000, p. 117) also suggest managing firefighter fluid replenishment through prehydration and rehydration. They recommend firefighting personnel should be adequately hydrated at all times and preferably slightly over hydrated entering an emergency scene. The strategies suggested to accomplish this include the following:

1. "Avoiding excessive use of caffeinated beverages while on duty, as these liquids promote excessive urination.
2. Avoiding excessive alcohol use before coming on duty: residual dehydration is common with hangovers.
3. Being aggressive about personal rehydration after strenuous, non-duty-related activities such as competitive sports or running.

4. Monitoring urine, which is a sensitive indicator of hydration status. Urine should be clear and odor free. Increase fluid intake if urine darkens."

For rehydration Dickinson and Wieder (2000, p. 118-120) recommend, "Although there may be some local variations, ideal rehydration solutions administered in rehab operations should, as noted, contain not only water but electrolytes and simple carbohydrates as well. Commercial sports drinks are readily available beverages containing these three major components." They suggest the beverage have a good taste, not be served too hot or cold, and should not be carbonated. They further recommend firefighters rotating through rehab after high intensity activity should ingest 12 to 30 ounces of fluid in a 30-minute rehabilitation period.

Treadwell (1999, p. 12) concludes in his research that water is the best choice for hydration. Water is the key to the body maintaining its ability to perspire and water is required to continue this effort. Kemp (1996, p. 12) reached the same conclusion in his review of current literature that water is the best choice for fluid replenishment.

In summary, although all of the sources emphasized the importance of rehydration, there was disagreement regarding the use of water or commercially prepared activity beverages for firefighter rehab. Additionally, Dickinson and Wieder (2000) stressed the importance of continued fluid intake after the incident. Coffee and carbonated drinks should not be served as caffeine can cause cardiac palpitations and coffee is a natural diuretic promoting dehydration (Bonanno, 1996).

During extended operations of three hours or more, along with providing for rehydration, the rehab should provide foods such as soups, broths, or stews which are preferable to fast foods as they are digested more quickly. Fruits, such as bananas, apples, and oranges are recommended as they provide energy replacement (Sachs, 1994). FEMA/USFA (1992) supports

Sachs (1994) in stating: "The department shall provide food at the scene of an extended incident when units are engaged for three or more hours. A cup of soup, broth, or stew is highly recommended because it is digested much faster than sandwiches and fast food products." Fruits are also recommended to provide supplemental energy replacement.

Dickinson (2000) states, "Solid foods provided to emergency personnel must meet two criteria: It must provide adequate and thoughtful nutrition and be served easily and safely to emergency personnel on scene." He also emphasizes that cold foods should be served at less than 40° F. and hot foods served at more than 140° F. For medium duration incidents, he recommends fruits for carbohydrate replacement. Dickinson (2000) also suggests, "Some departments use commercially available, individually packed snack bars for minor nutritional support. Departments should have their personnel taste test these bars prior to use in rehab and reach a consensus on an acceptable taste."

NFPA 1584 (2003, p. 8) recommends foods consumed during an incident should include carbohydrates such as fruits, vegetables, grains and starches, and proteins such as lean meats, legumes and protein supplements. Foods that are not recommended include high-fat meals or foods with excessive caloric content.

To summarize, Sachs (1994) concludes that on emergency incidents of three hours or more food should be provided as part of the rehab process. Sachs (1994), FEMA/USFA (1992), and Dickinson (2000) recommend warm food such as soups, broths, and stews for ease of digestion and carbohydrates such as fruits for incidents of medium duration. Foods of this type are generally considered healthy and usually do not promote digestive discomfort when personnel return to rigorous work activity. Dickinson (2000) suggests foods should be taste

tested by personnel prior to an incident to ensure they will be consumed. NFPA 1584 (2003) stresses high fat foods or foods with high caloric content are not recommended.

What factors indicate that a firefighter is rested and can return to incident operations?

Sachs (2001, p. 73) emphasizes, "Firefighters should have a place to rest and cool down for a minimum of 15 to 20 minutes." In addition he stresses, "Increased blood pressure, irregular heart rate, disorientation and a poor pulse oximetry reading indicate a firefighter may need rest and receive further evaluation before returning to duty."

FEMA/USFA (1992) stresses that a member sent to the Rehab Sector should have their pulse and temperature evaluated. If the temperature is below 100.6° F. and the heart rate remains above 110 beats per minute, then time in rehab should be increased. Heat stress is considered negligible in firefighters presenting with a pulse of less than 110 beats per minute.

Dickinson (2000) supports FEMA/USFA (1992) and in addition cites the Phoenix Fire Department Rehabilitation SOP that states, "Any patient with a temperature higher than 101° F. (38.3° C.), must receive IV hydration and be transported to an emergency department." Dickinson (2000) established the criteria for mandating continued time in the Rehab Sector to include a heart rate over 100 beats per minute or a blood pressure over 160 mm Hg systolic or under 100 mm Hg systolic. Finally, if the diastolic is over 90 mm Hg continued time in the Rehab Sector is required.

Angeli (2000) establishes the following parameters for returning to fire scene duty:

1. "Vital signs are within normal limits;
2. Absence of any abnormal signs and symptoms;
3. Completion of minimum period of 15 minutes for rest and rehydration."

NFPA 1584 (2003) does not provide guidance on parameters on when firefighters should return to duty from rehab. This recommended practice states:

> "Currently there are no studies that quantify vital sign measurements with the length of rehabilitation or with the need to direct members to the treatment area. Visual signs and symptoms remain the best method to evaluate members in the rehabilitation area. Vital sign measurements can be used as a baseline or to assist with treatment should it be deemed necessary" (p. 11).

In summary, Angeli (2000) and Sachs (2001) stress that members sent to the Rehab Sector should rest for at least 15 minutes and maintain vital signs within normal limits. In addition, members should be free of abnormal signs or symptoms. FEMA/USFA (1994) recommends members presenting with a pulse of less than 110 beats per minute and a temperature of less than 100.6° F. as a guideline for when an emergency incident responder can be released from the Rehab Sector. Dickenson (2000) established the criteria for keeping personnel in rehab based on heart rate and blood pressure. Dickenson (2000) cites a heart rate over 100 beats per minute and a blood pressure in excess of 160/100 or a diastolic blood pressure of over 90 indicate members should be assessed and mandated to remain in rehab. NFPA 1584 (2003) maintains there are limited studies on quantifying vital signs and recommends using visual signs and symptoms with baseline vital signs to assist in treatment or authorizing members for release from the rehab area.

PROCEDURES

Descriptive and evaluative research methodology was used to obtain information on the current recommended procedures for rehabilitation of personnel assigned to an emergency incident. This information was used to develop an SOP for OCFRD. Research included a

literary review of trade journals, books, recommended standards by the NFPA, and a recommended SOP developed by FEMA for the USFA. In addition, a review of Applied Research Projects on file at the National Fire Academy's Learning Resource Center was conducted.

A survey of fire departments serving predominately Florida and the southern United States was conducted to determine the procedures used by other fire departments to meet the need for an SOP on emergency incidents (Appendix B). The selected fire departments in Florida were derived from a list of fire departments provided by the Florida Department of Financial Services. Fire Departments throughout the south were selected at random with the contact and address obtained through the Internet. The cover letter that accompanied the survey requested a copy of the department's Rehab SOP, if one existed. A copy of the cover letter that accompanied the survey is listed in Appendix C.

An unstructured interview was conducted with Dr. Stanley C. Haimes, Medical Advisor for OCFRD and a member of the EMS Medical Control Committee for Orange County, Florida. Dr. Haimes is a board certified occupational medicine physician who completed his residency training at Johns Hopkins University. He is also a Certified Industrial Hygienist and Certified Safety Professional.

Assumptions and Limitations

Seventy surveys were sent to fire departments in Florida and throughout the South. Departments were chosen in the South due to similar climatic conditions. Central Florida's climate is predominately hot and humid for approximately eight months of the year. The other four to five months of the year are considered mild with temperatures rarely reaching the point of freezing. This research is primarily oriented to meeting the needs of responders during warm

weather months. A variety of departments were contacted to gain a broad cross section of resources and financial capabilities available to different departments. Sometimes, a department with limited financial resources can be very creative in meeting a need.

The State of Florida dealt with an unprecedented four hurricanes in the summer and fall of the 2004. Many of the southeastern states were affected as well. This may have created a limitation of the number of departments that responded to the survey.

Most of the questions in the survey provided the respondent with the opportunity to respond with all of the answers that applied. Most of the respondents gave multiple answers, which indicates that one specific answer would not apply. Some responses were incomplete or had sporadic answers. Attempts were made to contact the person completing the survey to resolve any questions. It is possible the respondent did not know the appropriate answer or because the information was not available. A copy of the survey is provided in Appendix B.

Definitions and Clarification of Selected Terms

Atrial Fibrillation – A cardiac condition whereby the heart beats irregularly due to electrical conduction problem within the heart.

Capnography – A recording of the concentration of carbon dioxide in expired air.

Diuretic – Any substance, which causes the increased output of urine.

Emergency Incident Rehab – The action of ensuring "that the physical and mental well being of members operating at the scene of an emergency (or training exercise) does not deteriorate to the point where it affects the safety of any other members" (Angeli, 2000).

Member – A person involved in performing duties of a department, under the direction of the organization (NFPA 1584, 2003).

Pulse Oximetry – The real-time display of both pulse rate and percentage of actual oxygen saturation in hemoglobin compared to the maximum possible oxygen which that hemoglobin can transport.

Sports Drink – A rehydration drink that is between four percent and eight percent carbohydrate and contains between 0.5 g and 0.7 g of sodium per liter of solution (NFPA 1584, 2003).

RESULTS

Seventy surveys (Appendix B) were sent to fire departments in the southern part of the United States with 31 (44%) sent to Florida fire departments. The response was good with 53 (76%) departments returning the survey. The survey instructions provided the respondent the opportunity to answer all questions with an "all that apply" response. The cover letter (Appendix C) requested a copy of the departmental Rehab SOP or guideline. Thirteen departments sent a copy of their Incident Rehabilitation SOP or guideline. Of the departments responding to the survey, 41 (77%) were paid only departments and 12 (23 %) were paid/volunteer combination departments. None of the departments surveyed were volunteer-only type fire departments.

NFPA 1584 (2003, p. 5) states, "The fire department should develop standard operation procedures (SOPs) that outline a systematic approach for the rehabilitation of members operating at incidents." With 39 (75%) departments stating they have a firefighter rehab SOP or guideline and 13 (25%) stating they did not have a firefighter rehab SOP or guideline, it appears most departments understand the benefits and the need for an emergency incident rehab SOP.

What factors should be used to determine when a firefighter should be sent to rehab?

Question three of the survey addressed this question by asking, "How does your department determine when a firefighter needs to be sent to rehab?" The four responses

provided the respondent with the opportunity to reply with all that apply. Answers (a) and (b) were open-ended and provided additional space for information about the respondent's department.

Twenty-six percent of the responding departments selected answer (a) stating time on scene was used to determine when personnel were sent to the Rehab Sector. Most (73%) use 45-60 minutes as the guideline as to when to send members to rehab. Eighteen percent use 30 minutes and nine percent use 20 minutes of scene time, usually with members involved in strenuous activity, as the guideline for sending members to the Rehab Sector.

Forty-five percent of the responding departments selected answer (b) the number of SCBA tanks used, as their guideline. Eighty-six percent of these respondents use the "two-air bottle rule" with 14 % sending members to rehab after using one tank. The most common size air tanks in use are limited to 20 to 30 minutes of use. Currently, there are 45 minute and 60 minute SCBA tanks available and it is not known how many of these departments may use this type of equipment.

Sixty-two percent of responding departments reported crews are sent to the Rehab Sector at Command's discretion. Seventy-five percent of the respondents stated the Company Officer or Sector Officer's discretion is used to determine when members were sent to rehab. Both of these responses follow the direction of NFPA 1584 (2003). A comparison of these responses is reflected in Appendix D, Figure D1.

What resources are required to establish an incident rehab sector?

Question four of the survey asked, "What resources can be requested in warm weather rehab?" Forty-three percent responded using a Rehab Response vehicle while 66% responded that volunteer assistance from the Red Cross, Salvation Army, or a firefighter auxiliary type

organization is requested. Forty-three percent replied that a transit bus is requested for a climate-controlled area. Nineteen percent responded that the fire department physician was requested for medical monitoring of personnel. Eighty-nine percent reported fire department or EMS transport is requested. The last category of answers provided for an open-ended *other* category. This information is reflected in Appendix D, Figure D2. The *other* category of responses included the use of a Decon trailer, Rehab tent, Hazmat unit, a trailer with air conditioning, and a Rehab bus with air conditioning and awnings.

Question five asked, "What equipment does your department use to establish a rehab area or sector?" Ninety-two percent of the respondents reported utilizing medical monitoring equipment. Fifty-one percent confirmed the use of portable awnings and 75 % responded to using fans or misting fans. Forty-three percent provided portable seating and 60% provided a climate-controlled vehicle. Twenty-five percent replied that portable toilets are provided. The final answer to question five provided an open-ended *other* category with responses including the use of salvage covers, ice, and documentation materials. Figure D3 of Appendix D illustrates this information.

What medical protocols should be followed during firefighter rehab?

Question six of the survey in Appendix B requested a yes or no response. The question asked, "Does your department require any medical monitoring during rehab?" Eighty-three percent of the respondents confirmed that medical monitoring of personnel in the Rehab Sector is required. This meets the recommended standard as established by the NFPA 1584 and FEMA/NFPA (1992).

Question seven of the survey in Appendix B asked, "If personnel are medically monitored, what types of tests are completed and documented?" Ninety-six percent responded

with taking a member's blood pressure and pulse. Sixty-two percent reported taking a member's temperature. Thirty-eight percent reported providing EKG monitoring for emergency incident workers. Forty-seven percent reported completing oxygen saturation tests or pulse oximetry. Seventy-seven percent responded with checking a member's respiration rate. Only 13% reported using capnography as a medical test completed and documented on members sent to rehab. A comparison of this information is reflected in Appendix D, Figure D4.

In an interview with Dr. Stanley Haimes (personal communication on December 21, 2004), he emphasized the importance of medical evaluation of members reporting to the Rehab Sector. A set of vital signs including blood pressure and pulse are only minimal tests with additional tests needed if vital signs are abnormal. He stressed EMS personnel should be aggressive in eliciting possible medical complaints from members. This is due to members feeling embarrassed about not being as tough as the rest of the crew or department.

Dr. Haimes stressed the importance of rehydration of personnel and supports the use of IV therapy if a member's vital signs are abnormal and he/she may be considered dehydrated. He expresses a high level of confidence in local EMS personnel and states that if the member's vital signs return to normal with IV therapy, transport to an Emergency Department should not be required.

In addition, Dr. Haimes stresses the importance of removing as much turnout equipment as possible to assist in heat loss allowing the member to more rapidly return to safe physiological parameters for return to emergency incident operations. If the member is no longer carrying the weight of turnout gear, SCBA, and firefighting tools, a reduction in the metabolic energy requirement and heat generation would occur. Furthermore, a beneficial psychological effect may also result by having the member place on the ground and walk away from his protective

equipment as it assists the member in removing himself from the psychological stress of the incident and creates another barrier to his premature return to incident operations (Dr. Stanley Haimes, personal communication on December 21, 2004).

What fluids and foods are recommended for firefighter rehab?

Question eight of the survey asked, "What types of food or drinks are provided for personnel when they are sent for rehab? (Note: This would not be for an extended operation or a meal break.)" All of the respondents reported to providing water to emergency incident members while ninety-four percent provided sports drinks (e.g. Gatorade). Thirteen percent replied that fruits are supplied to personnel. Only nine percent reported supplying soft or carbonated drinks. Thirty-two percent responded with providing snacks such as snack bars, chips, or crackers. Forty-three percent replied that hot beverages such as coffee or tea are provided. Thirteen percent reported that warm food such as soup was provided to emergency incident members. This information is portrayed in Appendix D, Figure D5.

Dr. Haimes (personal communication on December 21, 2004) advocates providing sports drinks over water for faster rehydration of members. He also emphasized serving the beverage in warm weather at not less than 40° F. He stated that sports drinks would not replenish fluid loss as fast as IV therapy but oral ingestion is more acceptable with less risk. Oral rehydration with sports drink is preferred due to the presence of glucose and potassium promoting direct absorption of water while still in the stomach before it gets in the small intestine. When glucose and potassium are not present, the absorption is delayed until water passes into the small intestine. The glucose, therefore, serves two purposes. It promotes the absorption of fluid and provides energy for the member by circulating into the blood as glucose until it is stored in the muscle and liver as glycogen. The increase in circulating fluid replaces the water lost due to

strenuous activity primarily via perspiration and to a lesser degree by exhalation. If the circulating fluid volume is not replaced, the result is a decrease in cardiac output. This is usually compensated by an increased heart rate as the body attempts to maintain cardiac output at an adequate level. When this form of compensation cannot be maintained, due to inadequate filling of the heart, the blood pressure will fall along with cardiac output. When the decrease in cardiac output can no longer provide the level of oxygenation required by the brain, the firefighter will lose consciousness. While this could be a protective mechanism in another setting, in that it abruptly decreases oxygen demand and places the individual in a horizontal position where the heart has less of a demand to oxygenate the brain, in a firefighting setting this could be fatal for the firefighter.

What factors indicate that a firefighter is rested and can return to incident operations?

Question nine of the survey queried, "What criteria are used to determine when personnel can return to active operations?" Fifty-one percent replied with the amount of time spent in rehab. This answer was open-ended and asked how long a member would remain in rehab before returning to active operations. Of the respondents stating that time was used as a factor to determine when personnel were released from rehab, 32% reported using 20 minutes as their guideline. Twenty-six percent replied to using 30 minutes as their guideline. Twenty-one percent used ten minutes as enough time to complete the rehab process for members. The other 21% used 15 minutes as the appropriate guideline.

Fifty-eight percent reported using changes in blood pressure as a factor to evaluate when to return personnel to operations. Sixty percent used pulse rate as a deciding factor for a member to resume activity in the operation of the incident. Forty-nine percent replied to using changes in body temperature. A comparison of responses is reflected in Appendix D, Figure D6.

Thirty-eight percent of respondents used *other* in answer to this question. The *other* answer provided an opportunity for an open-ended response and for input as to additional factors used to determine when to send personnel back to operations. Thirty percent of these respondents stated crews return to the operation of the incident at the sole discretion of the Rehab Officer. Thirty percent stated medical evaluation of members was required before the Rehab Officer would release personnel. Thirty percent left the criteria for release from Rehab up to the EMS personnel evaluating members. One respondent replied that members were released based on the need for members to return to the operation. Another respondent stated the decision was left up to the member depending upon how he or she felt after resting, and another required a member to consume a required amount of fluid before returning to operations.

DISCUSSION

NFPA 1584 (2003, p. 5) states, "The fire department should develop standard operating procedures (SOPs) that outline a systematic approach for the rehabilitation of members operating at incidents." Becker (2000) states in his suggestion for advanced rehab planning, "Develop guidelines and an implementation plan for on-scene rehab in advance of an incident. Proper rehab operations require a coordinated effort and should not be implemented in the middle of an emergency incident." FEMA/USFA (1992) suggests, "A successful rehabilitation program will improve the morale of the department and increase the level of productivity." With 39 (75%) departments stating they have a firefighter rehab SOP or guideline and 13 (25%) stating they did not have a firefighter rehab SOP or guideline, it appears most departments understand the benefits and the need for an emergency incident rehab SOP. Although OCFRD has a Rehab truck and as a general rule sets up a Rehab Sector, the operation is inconsistent and does not

follow a set of guidelines. In addition, very little documentation is completed unless a firefighter is injured or requires transport to an Emergency Room.

What factors should be used to determine when a firefighter should be sent to rehab?

Seventy-five percent of the respondents stated the factor used to determine when a firefighter is sent to rehab was the Company Officer's or the Sector Officer's discretion. Sixty-two percent replied that crews report to the Rehab Sector at Command's discretion. Both of these responses follow the direction of NFPA 1584 (2003), which states that rehab operations should commence when the Incident Commander determines the operation poses a risk due to exceeding a safe level of endurance.

Forty-five percent stated the use of SCBA tanks was a guideline used. Eighty-six percent of these respondents use the "two air bottle rule" with 14% using one tank before sending personnel to rehab. Angeli (2000), Carafano (1990), and FEMA/USFA (1992) support the "two air bottle rule" as well. Four respondents reported using one tank as the guideline in their department. The most common size air tanks in use are limited to 20 to 30 minutes of use. Currently, there are 45 minute and 60 minute SCBA tanks available and it is not known if these departments may use this type of equipment.

Twenty-six percent of those responding to this question stated time on scene was used to determine when personnel were sent to the Rehab Sector. Most, 73%, use 45-60 minutes as the guideline for when to send members to rehab. Angeli (2000), Bonanno (1992), Carafano (1990), and FEMA/USFA (1992) all support 30 to 45 minutes of strenuous activity as the guideline for rehabilitation of emergency incident personnel. The other 27% of the respondents use 30 minutes or less of strenuous activity as their guideline for requiring members to report to the Rehab area.

The consensus of the reviewed literature supports the use of two air tanks or 30 to 45 minutes of vigorous activity as a guideline as to when members should report to a Rehab Sector. The survey indicated that most fire departments use the same type of guideline as presented by the literature. Most use the discretion of the members' Company Officer/Sector Officer or the discretion of the Incident Commander to determine if a member needs to be sent to Rehab. OCFRD only provides for the Incident Commander to use his or her discretion as to when a Rehab Sector is established and when personnel are sent. OCFRD without an SOP does not have prescribed guidelines as to when a Rehab Sector should be established. Depending on the size of the incident, a Rescue crew may simply be ordered to establish a rehab area and provide water. This is not compliant with NFPA 1584 (2003) and contradicts the information provided in the literature reviewed.

What resources are required to establish an incident rehab sector?

Angeli (2000), Becker (2000), and FEMA/USFA (1992) support an established Rehab Sector with a Rehab Officer in charge of this operation. The Rehab Officer is responsible for selecting a proper site, and obtaining necessary staffing, supplies, and equipment. It is his responsibility to ensure proper documentation is completed and maintain accountability for personnel sent to this sector. The completed surveys indicated 77% of the respondents stated their departments utilize an SOP for the management of Emergency Incident or training rehab. Of the 13 departments that sent a copy of their SOP or guideline, all referred to an established Rehab Officer.

Angeli (2000), Becker (2000), FEMA/USFA (1992), and NFPA 1584 (2003) suggest the location of the Rehab Sector should be convenient to the incident but suitably distanced from the incident. The rehab area should be free of smoke, exhaust, and provide some protection from the

elements. The site should be large enough to accommodate the incident and be adjacent to medical treatment and transport areas. Angeli (2000) supports locating the rehab area in close proximity to the air tank refilling operations to enable members to be completely prepared to return to operations.

Eighty-nine percent of the departments surveyed utilize EMS or Fire Department Transport as part of the Rehab Sector operations. Nineteen percent request a fire department physician for medical monitoring of personnel. Angeli (2000), Becker (2000), FEMA/USFA (1992), and NFPA 1584 (2003) state that two trained medical personnel with at least one of them qualified as paramedic should be included in the resources needed to properly staff and operate an Emergency Incident Rehab Sector. In support of this aspect of the Rehab Sector, 92% of the departments surveyed use medical monitoring equipment as part of the necessary rehab resource equipment.

What medical protocols should be followed during firefighter rehab?

FEMA/USFA (1992) stressed the importance of medical evaluations of members sent to the rehab area. Later documentation by Treadwell (1999), Wieder (1999), Angeli (2000), Heightman and O'Keefe (2000), Sachs (2001), and NFPA 1584 (2003) all support medical evaluation of members sent to the rehab area. In the survey, 83% of the responding departments stated medical monitoring was required of members sent to the Rehab Sector. This leads to the conclusion that most departments are aware of the opportunity to prevent serious illness or injury by medically monitoring personnel in the Rehab Sector. Although OCFRD generally will check members sent to the rehab area if an injury is noted, there is no requirement set forth to ensure that all members are medically monitored. On many occasions, a firefighter/EMT and a

firefighter/paramedic who have been actively involved in the incident or training and are weary from incident operations are then ordered to set up a rehab area.

FEMA/USFA (1992) stressed the importance of immediate evaluation of pulse and temperature when members arrive at rehab. Treadwell (1999), Wieder (1999), Angeli (2000), Heightman and O'Keefe (2000), Sachs (2001), and NFPA 1584 (2003) concur that a full set of vital signs be taken upon arrival at rehab. The vital signs include blood pressure, pulse, and temperature. Angeli (2000) and Sachs (2001) support the additional use of pulse oximetry in evaluation of members.

The results of the survey indicated 96% of the responding departments required the monitoring of blood pressure and pulse. Seventy-seven percent required that the respiration rate be checked with 62% taking the member's temperature. Thirty-eight percent required EKG monitoring of all members while 47% required the use of pulse oximetry. The use of capnography is limited to ALS providers but is growing in its recognition and acceptance. Thirteen percent of the responding departments require the use of capnography for the assessments of its members.

Dr. Haimes emphasized the importance of a full set of vital signs including blood pressure, pulse, and respiration rate, and suggested additional medical tests if the vital signs are abnormal. He also stressed the importance of EMS personnel aggressively attempting to elicit medical complaints from members due to possible embarrassment of members feeling they are not as rugged as the rest of their crew. Dr. Haimes expressed concern that EMS personnel need to question members receiving a medical evaluation about their medications as certain medications, especially beta blockers, will retard the heart rate (Dr. Haimes, personal communication on December 21, 2004).

Without a directive or an SOP, medical monitoring by OCFRD EMS personnel is generally haphazard and completed only if directed or if the member presents with a medical complaint. Many times, the EMS personnel will detect a change in behavior or see a sign or symptom to indicate medical monitoring of a member may be necessary. There have been a few occasions on major incidents where the Medical Director has been aggressive in pursuing medical monitoring and authorizing the initiation of IV therapy for members he considered dehydrated.

What fluids and foods are recommended for firefighter rehab?

The review of literature found varied recommendations for the fluid of choice for rehydration of members. All of the sources stressed the need for rehydration; however, there appeared to be an even split between water and sports drinks. Research by Kemp in 1996 and Treadwell in 1999 concluded that water was the best choice. Bonanno (1996) stresses the importance of carbohydrate replacement in addition to fluid replacement. NFPA 1584 (2003) rates sports drinks as the best choice for fluid replacement. Finally, Bonanno (1996) as well as Dickinson and Wieder (2000) emphasize coffee and carbonated beverages should not be provided as caffeine can cause heart palpitations, and coffee is a natural diuretic.

All of the respondents to the survey indicated that water was made available to members reporting for rehab. Ninety-four percent reported sports drinks were provided at the rehab area. Surprisingly, 43% provided coffee or tea for members reporting to the rehab area, while only nine percent provided carbonated or soft drinks. Dr. Haimes is very implicit in his conclusion that sports drinks are better for rehydration than water and provided detailed information on his reasoning. Dr. Haimes also discouraged supplying coffee, tea, or carbonated beverages for the previously stated reasons.

When a rehab area is set up by OCFRD, water and occasionally sports drinks are provided based on the size and complexity of the incident. Coffee is occasionally provided if the weather is cold and the Rehab truck has been requested. This research will be of benefit in establishing a logical reason why carbonated fluids and drinks with caffeine should not be provided.

Sachs (1994) and FEMA/USFA (1992) suggest food should be provided to members on incidents of three hours or more in duration. Sachs (1994), FEMA/USFA (1992), and Dickinson (2000) recommend warm foods such as soups, broths, and stews for ease of digestion and fruits for incidents of medium duration. NFPA 1584 (2003) recommends foods such as fruits, vegetables, grains and starches, and proteins such as lean meats, legumes, and protein supplements. NFPA 1584 (2003) further states that foods that are high in fat or caloric content should be discouraged.

Thirty-two percent of the departments surveyed reported providing snacks such as snack bars, chips, or crackers. Only thirteen percent reported providing warm food such as soup to emergency incident members.

OCFRD provides snacks such as snack bars and crackers on medium duration incidents and sandwiches on incidents of long duration such as full day. It is difficult to provide warm food, as the means to prepare and keep the food warm is not always readily available. This research can provide justification for the acquisition of the equipment needed to provide properly prepared fluids and foods.

What factors indicate that a firefighter is rested and can return to incident operations?

Angeli (2000) and Sachs (2001) advocate members sent to Rehab should rest for at least 15 minutes, maintain normal vital signs, and be void of abnormal signs or symptoms. Fifty-one

percent of the respondents to the survey indicated time was a deciding factor for when a member should be rested and able to return to operations. Seventy-nine percent of the respondents stated the rehab period should be at least 15 minutes and 58% reported the rehab period should be 20 minutes or more.

FEMA/USFA (1992) and Dickinson (2000) support medical monitoring of vital signs and temperature as the determining factor for when members should be sent back to incident operations. Fifty-eight percent of the respondents of the survey indicated blood pressure was a factor in returning members to active operations. Sixty percent used pulse as a determining factor for returning members to operations, and 49% used body temperature as a determining factor for returning members to emergency operations. NFPA 1584 (2003) maintains there are limited studies on the use of qualifying vital signs and advocates using visual signs and symptoms with baseline vital signs to assist in treatment or authorizing members for return to emergency operations.

Question nine of the survey gave the respondent the option of an open-ended *other* answer. This gave the respondent the opportunity to provide input of additional factors which may be used to determine when members would return to active operations. Of those selecting the *other* category, a total of 60% of the respondents used medical evaluation as the determining factor for returning members to active operations. Thirty percent left the decision to release members from the rehab area up to the discretion of the Rehab Officer.

It is clear that departments with Rehab operation guidelines use time and medical monitoring as the determining factors for returning members to active operations. An established set of guidelines that are used and practiced provides an organized approach ensuring members are ready to return to emergency operations. Since OCFRD currently does not have

specific guidelines for returning members to active emergency operations, it is generally done at the discretion of the Rehab Officer or when a crew feels like they have rested and are ready to return to operations. This creates a situation in which a member may not feel well or may present signs and symptoms that should be addressed, but the member may be reluctant to express his medical concerns for fear of embarrassment. For decades the most common cause of firefighter fatalities is heart attack or stroke and the most common sign of a heart attack is denial.

RECOMMENDATIONS

The researcher recommends that OCFRD establish and implement the Emergency Incident SOP as proposed in Appendix D. This SOP follows NFPA 1584 (2003) and FEMA/ USFA (1992) guidelines using this research and this researcher's knowledge of OCFRD to develop a procedure that will benefit the department. In addition, when a rehab area is established, an Emergency Incident Rehabilitation Report (Appendix E) is completed to ensure proper documentation of crew accountability, crew rotation, and medical monitoring.

A training program should be instituted to ensure the SOP is followed and implemented properly. Firefighters tend to be embarrassed to admit they may need rest and rehabilitation. As a result, they will work until they can either no longer function or the incident is controlled. Training would educate the firefighters on the positive benefits of the SOP including the improved safety provided for all personnel.

This researcher recommends that OCFRD approach the Orange County EMS Council and the Medical Director to research the benefits of establishing an EMS protocol addressing a specific treatment of firefighter heat stress. There are eight fire departments in Orange County and all would benefit from a protocol of this type.

All fire departments without a formal Emergency Incident Rehabilitation SOP should establish and implement an SOP of this type. The benefits of this SOP would be the improved health and safety of personnel as well as the early detection of potentially serious medical problems and possibly save a firefighter's life.

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APPENDIX A

Heat Stress Index

Relative Humidity (percent)	Air Temperature (°F)										
	70	75	80	85	90	95	100	105	110	115	120
	Apparent Temperature (°F)										
0	64	69	73	78	83	87	91	95	99	103	107
10	65	70	75	80	85	90	95	100	105	111	116
20	66	72	77	82	87	93	99	105	112	120	130
30	67	73	78	84	90	96	104	113	123	135	148
40	68	74	79	86	93	101	110	123	137	151	
50	69	75	81	88	96	107	120	135	150		
60	70	76	82	90	100	114	132	149			
70	70	77	85	93	106	124	144				
80	71	78	86	97	113	136	157				
90	71	79	88	102	122	150	170				
100	72	80	91	108	133	166					

Apparent Temperature (°F)	Danger Category	Injury Threat
Below 80	None	Little or no danger under normal circumstances
80-90	Caution	Fatigue possible if exposure is prolonged and there is physical activity
91-105	Extreme Caution	Heat cramps and heat exhaustion possible if exposure is prolonged and there is physical activity
106-130	Danger	Heat cramps or exhaustion likely, heat stroke possible if exposure is prolonged and there is physical activity
Above 130	Extreme Danger	Heat stroke imminent!

Note: Add 10^{o} F when protective clothing is worn and add 10^{o} F when in direct sunlight.
Source: U.S. Fire Administration, FA-114, Emergency Incident Rehabilitation, July 1992.

APPENDIX B

NATIONAL FIRE ACADEMY

EXECUTIVE FIRE OFFICER PROGRAM

SURVEY OF FIRE DEPARTMENTS ADDRESSING REHAB FOR FIREFIGHTING PERSONNEL ON EMERGENCY OR TRAINING OPERATIONS

Name of your fire protection department or agency: _____

_____

Name and telephone or email of person completing this survey (If further information or clarification were needed, how would you like to be contacted?): _____

_____

_____ Number of fire stations

Please circle <u>all</u> that apply:

1. What type is your department?
   a. Paid
   b. Volunteer
   c. Combination (volunteer/paid)
2. Does your department have a Standard Operating Procedure or Guideline addressing the issue of firefighter rehab on Emergency or training operations?
   a. Yes
   b. No
3. How does your department determine when a firefighter needs to be sent to rehab?
   a. Time on scene (how much time?): _____
   b. Number of SCBA tanks used (how many?): _____
   c. Command's discretion
   d. Company Officer or Sector Officer discretion

4. What resources can be requested for a warm weather rehab?

    a. Rehab Response vehicle

    b. Volunteer assistance such as Red Cross, Salvation Army, or a firefighter auxiliary type of organization.

    c. Transit bus for a portable climate controlled area.

    d. Fire Department physician for assistance with medical monitoring of personnel.

    e. Fire Department medical transport or EMS transport unit.

    f. Other (please describe):

    _____

5. What equipment does your department use to establish a rehab area or sector?

    a. Medical monitoring equipment

    b. Portable awnings

    c. Fans or misting fans

    d. Portable seating

    e. Climate controlled vehicle

    f. Portable toilets

    g. Other (please describe):

    _____

6. Does your department require any medical monitoring during rehab?

    a. Yes

    b. No

7. If personnel are medically monitored, what types of tests are completed and documented?

    a. Blood Pressure

    b. Pulse

    c. Body Temperature

    d. EKG Monitoring

    e. Oxygen Saturation

    f. Respiration Rate

    g. Capnography (Respiratory carbon dioxide generation rate)

8. What types of food or drinks are provided for personnel when they are sent for rehab? (Note: This would not be for an extended operation and/or a meal break.)

    a. Water

    b. Sports drinks (i.e. Gatorade)

    c. Fruits

    d. Soft drinks (carbonated drinks)

    e. Snacks (snack bars, chips, crackers)

    f. Hot beverages (coffee or tea)

    g. Warm food such as soup

9. What criteria are used to determine when personnel can return to active operations?

    a. Time in rehab (how long?) _____

    b. Changes in blood pressure

    c. Changes in pulse rate

    d. Changes in body temperature

    e. Other, please specify: _____

Please return completed survey by November 1, 2004 to: Kenneth Burke, Orange County Fire Rescue, P.O. Box 5879, Winter Park, FL 32793-5879.

APPENDIX C

Cover Letter for Firefighter Rehab Survey

Date

Dear Chief:

The purpose of this letter is to request your assistance with a survey I am currently conducting to obtain information with regard to how your department responds to the need for firefighter rehab during emergency incidents or training during hot weather. The results of this survey will be included in an applied research project for the National Fire Academy as part of the Executive Fire Officer Program.

Please take the time to complete the enclosed survey and return in the enclosed, self-addressed, stamped envelope by November 1, 2004. If you have any questions, please feel free to contact me via phone at 407-323-1075 or email at burkekena@cs.com. In addition, if your department has a Standard Operating Procedure addressing firefighter rehab, please email or send it to me with the survey. Your assistance with this information is greatly appreciated.

Sincerely,

Kenneth A. Burke
EMS Supervisor
Orange County Fire Rescue Department

Enclosures

APPENDIX D

Figure D1

Survey Question 3: How does your department determine when a firefighter needs to be sent to rehab?

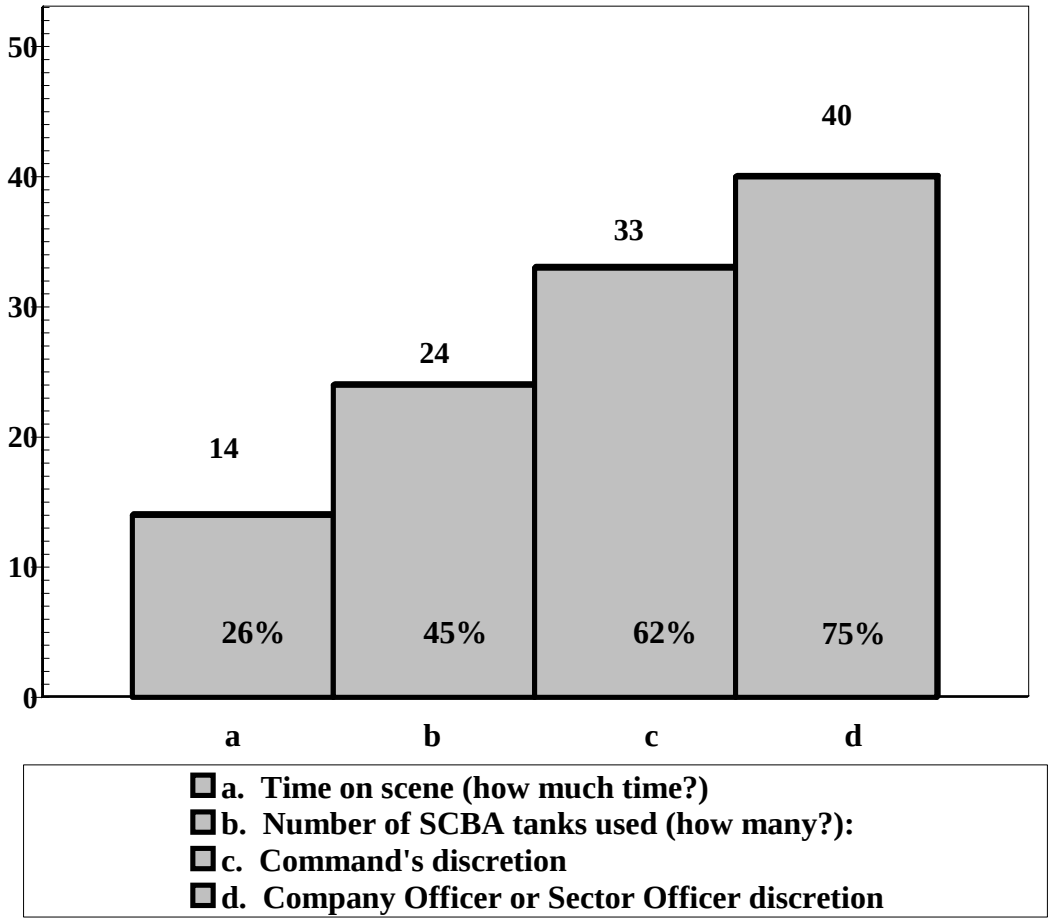
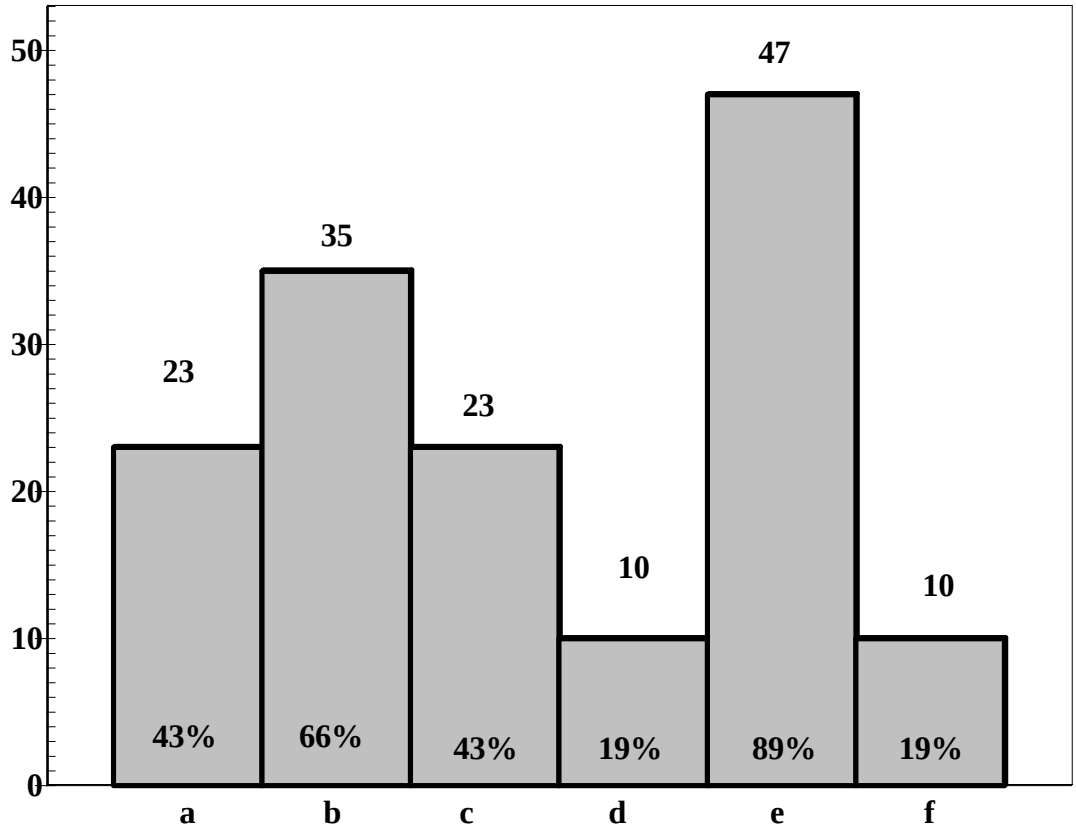


Figure D2

Survey Question 4: What resources can be requested for a warm weather rehab?



- ☐ **a. Rehab Response vehicle**
- ☐ **b. Volunteer assistance such as Red Cross, Salvation Army, or a firefighter auxiliary type of organization.**
- ☐ **c. Transit bus for a portable climate controlled area.**
- ☐ **d. Fire Department physician for assistance with medical monitoring of personnel**
- ☐ **e. Fire Department medical transport or EMS transport unit.**
- ☐ **f. Other (please describe):**

Figure D3

Survey Question 5: What equipment does your department use to establish a rehab area or sector?

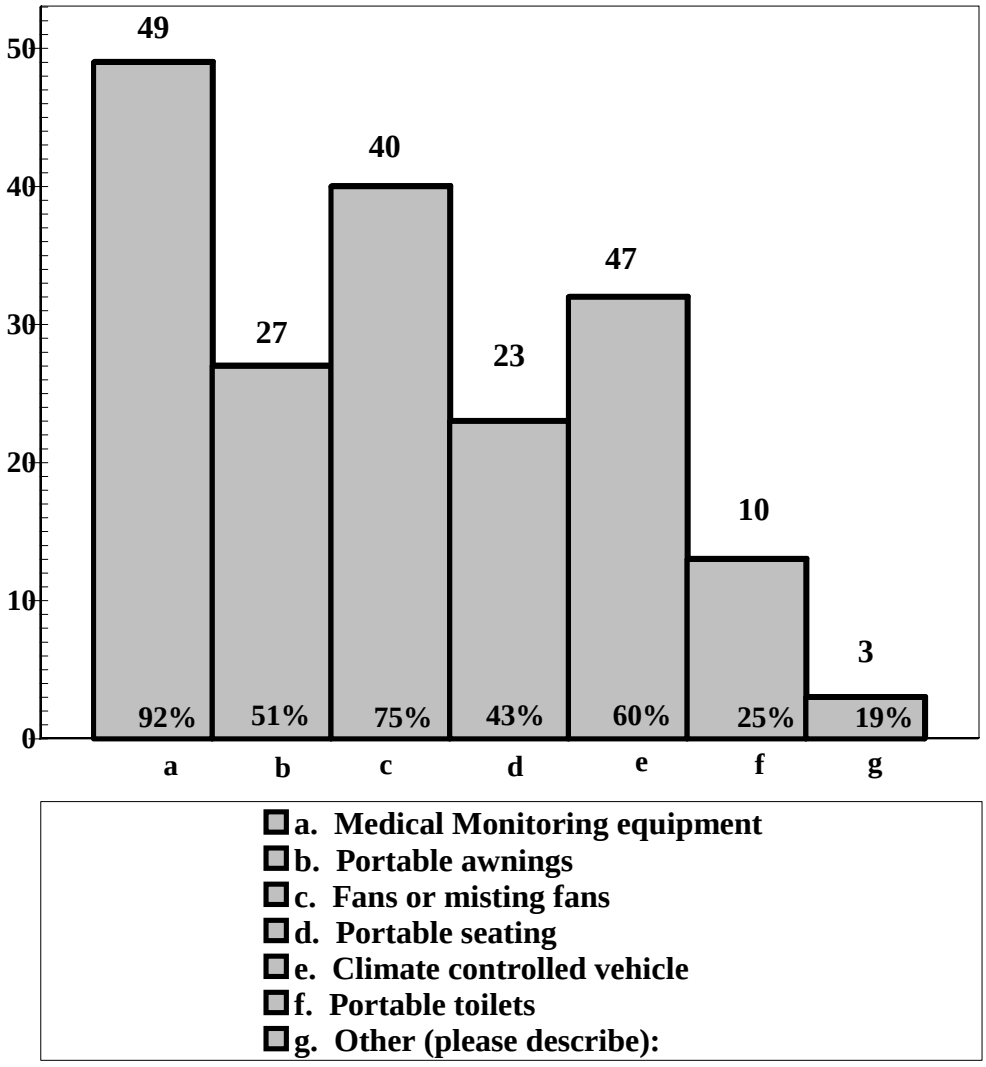


Figure D4

Survey Question 7: If personnel are medically monitored, what types of tests are completed and documented?

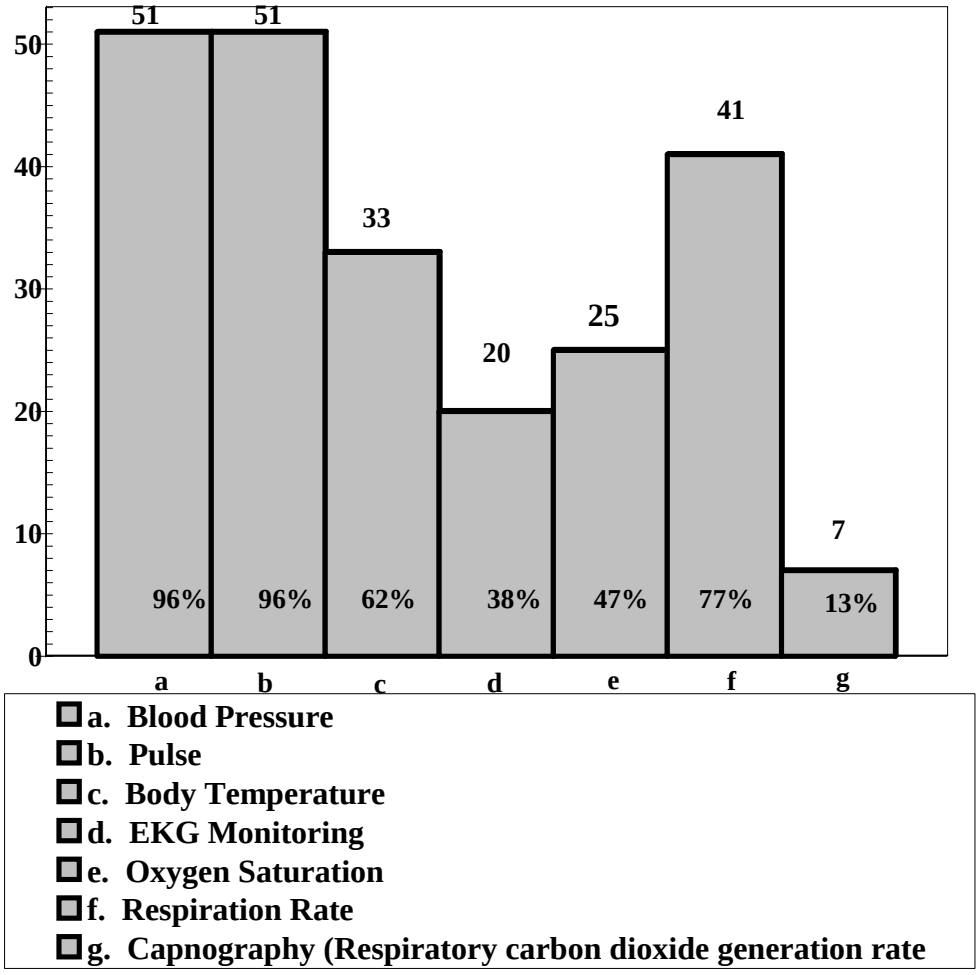


Figure D5

Survey Question 8: What types of food or drinks are provided for personnel when they are sent for rehab? (Note: This would not be for an extended operation and/or a meal break.)

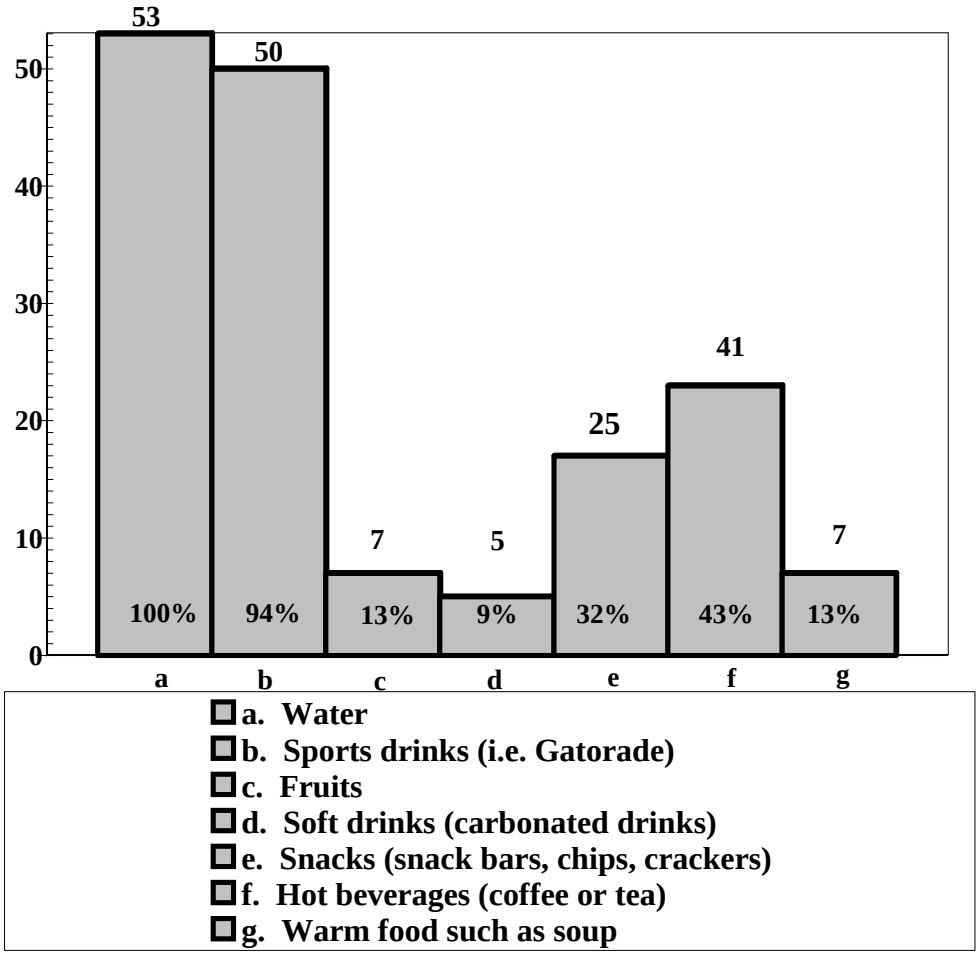
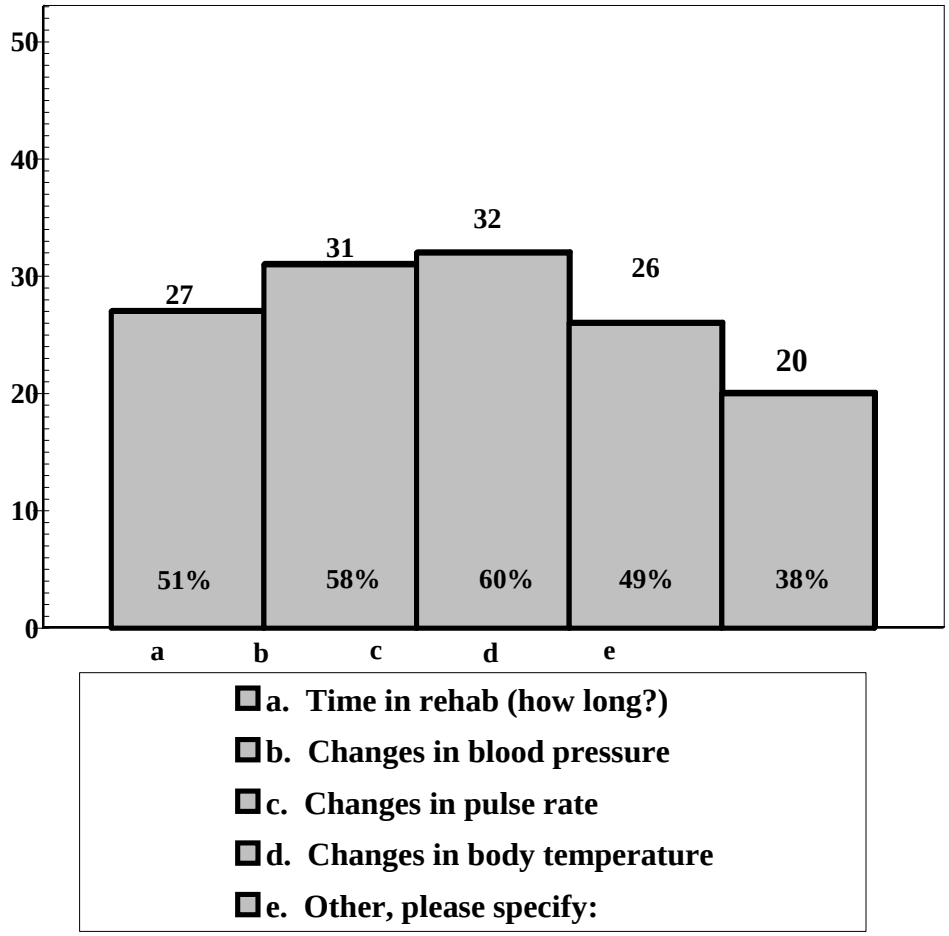


Figure D6

Survey Question 9: What criteria are used to determine when personnel can return to active operations?



APPENDIX E

ORANGE COUNTY FIRE RESCUE DEPARTMENT

Standard Operating Procedures			ISSUE: 12.0
Division: **Operations**		EFFECTIVE: **DRAFT**	REVISION:
AUTHORITY: **T.J. Lyon, Deputy Chief**			INITIALS:
SUBJECT: **EMERGENCY INCIDENT/TRAINING REHABILITATION**			PAGE: 1 of 5

12.0 PURPOSE

To ensure that the physical and mental condition of members operating at the scene of an emergency or a training exercise does not deteriorate to a point that affects the safety of each member or that jeopardizes the safety and integrity of the operation.

12.1 SCOPE

This procedure shall apply to all emergency operations and training exercises where strenuous physical activity or exposure to heat or cold exists.

12.2 RESPONSIBILITIES

A. Incident Commander: The Incident commander shall consider the circum stances of each incident and make adequate provisions early in the incident for rest and rehabilitation for all members operating at the scene. These provisions shall include: medical evaluation, treatment and monitoring; food and fluid replenishment; mental rest; and relief from extreme climatic conditions and the other environmental parameters of the incident. The rehabilitation shall include the provision of Emergency Medical Services (EMS) at the Basic Life Support Level (BLS) or higher.

B. Supervisors: All supervisors shall maintain an awareness of the conditions of each member operation within their span of control and ensure that adequate steps are taken to provide for each member's safety and health. The Command structure shall be utilized to request relief and the reassignment of fatigued crews.

C. Personnel: During periods of hot weather, members shall be encouraged to drink water and beverages throughout the workday. Beverages such as coffee, carbonated drinks and beverages with caffeine should be discouraged or limited. During any emergency incident or training evolution, all members shall advise their officer when they believe that their level of fatigue or exposure to heat or cold is

approaching a level that could affect themselves, their crew, or the operation in which they are involved. Members shall also remain aware of the health and safety of other members of their crew.

12.3:Definitions

A. Level 1 Rehabilitation: For those situations that are of short duration on first alarms.

1. The Incident Commander may elect to use the rehab supplies located on the Engine or Rescue on the scene.

2. Fire Department personnel will perform medical monitoring. If members show signs or symptoms of medical problems further evaluation and treatment will be provided and the Incident Commander notified.

B. Level II Rehabilitation: Implemented on 2nd or greater alarms, hazardous materials incidents involving the Hazardous Materials Squads, or for situations requiring a major time and personnel commitment from firefighting forces.

1. The Incident Commander will call for the Rehab vehicle to be brought to the scene.

2. An additional Rescue truck will respond to scene to assist with medical monitoring and for possible transport of members.

3. Staff personnel from the Finance office may be need to be requested to assist in the procurement of supplies such as food based on the duration and size of the operation.

12.4 ESTABLISHMENT OF A REHABILITATION SECTOR

A. Responsibility: The Incident Commander will establish a Rehabilitation Sector when conditions indicate that, rest and rehabilitation is needed for personnel and operating at an incident scene or training evolution. A paramedic, preferably a Lieutenant/Paramedic, will be placed in charge of the sector and shall be known as the Rehab Officer. The Rehab Officer shall report to Command. The Incident Commander will determine if Level I or Level II rehab will be implemented.

B. Location: The Incident Commander will normally designate the location of the Rehab area. If a specific location has not been designated the Rehab Officer shall select an appropriate site.

C. Site Characteristics

1. It should be in a location that will provide physical rest by allowing the body to recuperate from the demands and hazards of the emergency operation or training evolution.

2. It should be far enough away from the scene that members may safely remove their bunker gear and SCBA and be afforded mental rest from the stress and pressure of the emergency operation or training evolution.

3. It should provide suitable protection from the prevailing environmental conditions. During hot weather, it should be in a cool, shaded area. During cold weather, it should be in a warm, dry area.

4. It should enable members to be free of exhaust fumes from apparatus, vehicles or equipment include those involved in the Rehab Sector.

5. It should be large enough to accommodate multiple crews, based on the size of the incident.

6. It should be readily accessible for EMS transport.

7. It should allow prompt reentry back into the emergency operation upon complete recuperation.

8. The Rehab Sector boundaries should be defined with one entry and one exit point to ensure accountability.

D. Site Designations

1. A nearby garage, building lobby, or other structure.

2. Several floors below a fire in a high-rise building.

3. A school bus, municipal bus, or bookmobile

4. Fire apparatus, ambulance, or other emergency vehicle at the scene or called to the scene.

5. An open area in which a rehab area can be created.

E. Resources: The Rehab Officer shall secure the necessary resources required to adequately staff and supply the Rehabilitation area based on the necessary level of response (Level I or Level II Rehab). The supplies necessary for the operation should include:

1. Fluids – water, activity or sports beverage, and ice

2. Foods – Fruits such as apples, oranges, and bananas; warm foods such as soup, broth, or stew provided in hot/cold cups

3. Medical – Standard equipment on an OCFRD Rescue

4. Other items – awnings, fans, misting fans, extra equipment, blankets, towels, portable chairs, fire-line tape, ice chests and any items which may be deemed by the Rehab officer needed to accomplish firefighter rest and rehabilitation.

12.4 Guidelines

A. Rehabilitation Sector Establishment: The Incident Commander or his staff should consider the establishment of the Rehab Sector in the planning stages of the emergency response. However, the climatic or environmental conditions of the emergency scene should not be the sole justification for establishing a Rehab area. Any operation depending on its size, duration and/or labor intensive level can rapidly deplete personnel and therefore merits the consideration for rehabilitation.

B. Hydration: A critical factor in the prevention of heat injury is the maintenance of water and electrolytes. Water must be replace during exercise periods, training evolutions, and at emergency incidents. During heat stress, personnel should attempt to consume at least one quart of water or rehydration solution per hour. A rehydration solution will replace fluids lost by the body during exertion faster than water. The rehydration solution should be a 50/50 mixture of water and commercially prepared activity beverage and administered at about 40° F. Rehydration is important even in cold weather operations as heat stress may occur due to strenuous activity when protective equipment is worn. Coffee, beverages with caffeine, and carbonated beverages should be avoided before and during periods of heat stress.

C. Nourishment: The Rehab Officer should consider the need for food at the scene of an extended incident when units are engaged for three or more hours. Food such as apples, oranges and bananas provide supplemental forms of carbohydrate and energy replacement. A cup of soup, broth, or stew is recommended instead of sugary snacks due to the ease of digestion. However this may not be logistically possible on many incidents. Fatty, high caloric, or salty foods should be avoided.

D. Rest: The use of one 45-minute air tank or 45 minutes of exertion is the recommended level of activity prior to initiation of rehabilitation. Firefighter shall rest and rehydrate while the SCBA cylinders are filled or switched. The objective evaluation of the level of a firefighter's level of fatigue shall be the criteria for rehab time. Rest should be for less than 15 minutes and may exceed an hour as determined by the Rehab Officer. Fresh crews, or crews on "available status" from the Rehab Sector shall be returned to incident operations to ensure that fatigued

personnel are not required to return to duty before they are rested, evaluated and released by the Rehab Officer.

E. Recovery: Personnel in the Rehab area should consume plenty of fluids to improve their level of hydration. Personnel should not be moved from a hot environment directly into an air-conditioned area because the body's cooling system can shut down in response to the external cooling. An air-conditioned environment is acceptable after a cool-down period at ambient temperature with sufficient air movement. Personnel should be aware that certain drugs impair the body's ability to sweat and caution should be exercise if the firefighter is taking antihistamines, diuretics or stimulants.

F. Medical Evaluation:

1. EMS providers in the Rehab sector shall evaluate all firefighters sent to the Rehab Sector. The evaluations will include at a minimum of blood pressure, pulse, temperature and pulse oximetry. EMS providers shall evaluate vital signs, examine firefighters and determine their proper disposition (return to duty, continued rehabilitation, or medical treatment and transport to an Emergency Room). Medical treatment for firefighters, whose signs and/or symptoms indicate potential problems, should be treated in accordance with Orange County EMS Protocols. EMS providers should be assertive in and effort to find potential medical problems early.

2. Medical Monitoring – Vitals signs should be evaluated as soon as possible in the rest period. If a firefighter's pulse exceeds 110 beats per minute and temperature exceed 100.6° F., the firefighter should not remain in bunker gear and the rehab period should be extended. If the firefighter's temperature is below 100.6° F. and the pulse is below 110, the chance of heat stress is negligible.
3. Documentation – All medical evaluations shall be recorded on the attached Emergency Incident Rehabilitation Report. Any firefighters requiring additional treatment and/or transport shall have the standard OCFRD Trauma report completed.

G. Accountability: Personnel sent to the Rehab sector shall enter and exit as a crew. The crew designation, firefighter's names and times of entry and exit shall be documented. Crews will not leave the Rehab area for reassignment by Command until authorized by the Rehab Officer.

12.5 REFERENCES

A. Emergency Incident Rehabilitation (FA-114) – FEMA/USFA

B. NFPA 1584 (2003 ed.)

APPENDIX F

ORANGE COUNTY FIRE RESCUE
EMERGENCY INCIDENT REHABILIATION REPORT

Date	**Incident #**	**Location**	**Rehab Officer**

Name/Company	Time in	Pulse Rate	B/P	Temp	Time out	Pulse Rate	Comments